Electronic Supplementary Material (ESI) for Analytical Methods.
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Electronic Supplementary Material

An ultrasensitive "turn-off" SERS sensor for quantitatively detecting heparin based on 4-mercaptobenzoic acid functionalized gold nanoparticles

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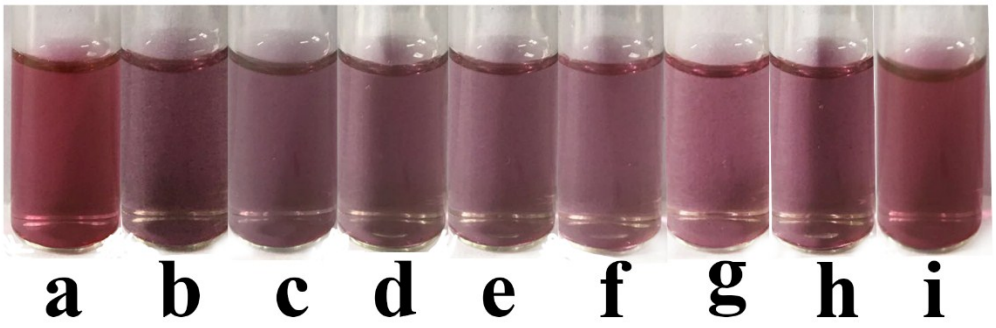

Fig. S1. Photographs of 4-MBA-AuNPs/protamine in aqueous solution with different heparin concentrations: (a) 4-MBA functionalized AuNPs; (b) 0ng/mL; (c)0.05ng/ mL; (d)0.1ng/ mL; (e) 0.5ng/mL; (f)1.0 ng/mL; (g) 5.0ng/mL; (h)10ng/ mL; (i) 20ng/mL;

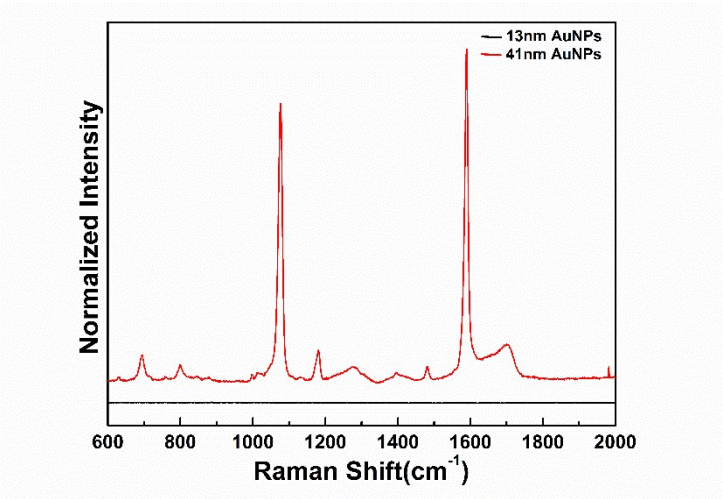

Fig. S2. The size effect of gold nanoparticles in the presence of 0.4 μg/mL protamine

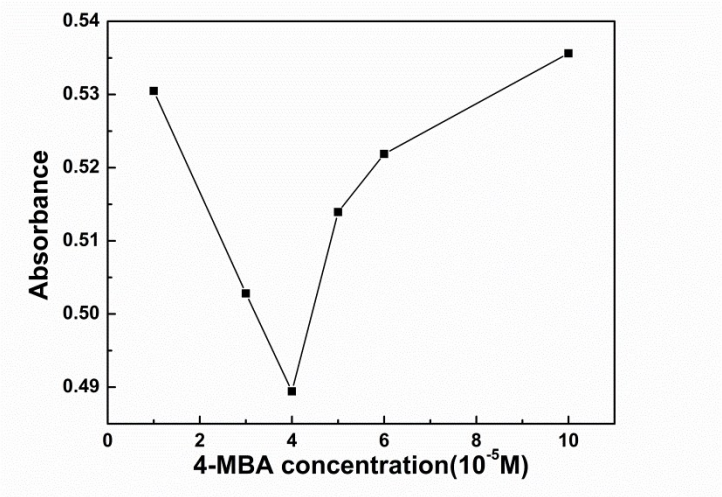

Fig. S3. The relationship between concentrations of Raman reporter and the maximum absorbance around 535 nm

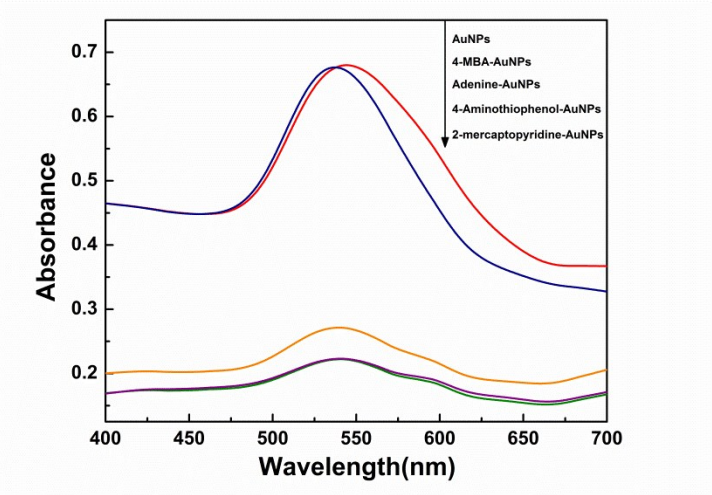

Fig. S4. The optimization of probe molecule types

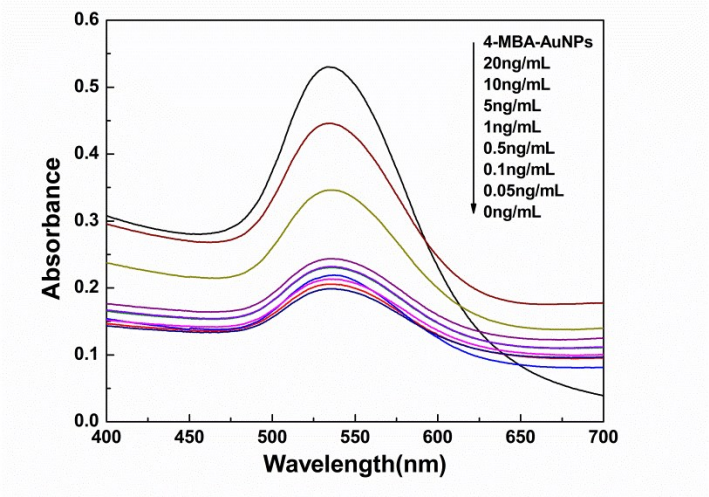

Fig. S5. UV-vis spectra of 4-MBA-AuNPs in the presence of heparin with different concentrations

Table S1. The comparison of our work and others.

Method	Linear range	LOD	Application	Ref.
SERS	0.05-20ng/mL	0.03ng/mL	FBS	Our work
SERS	0.2-2.4U/mL	0.042U/mL	Human serum	1[1]
Fluorescence	0.002-1.4μg/mL	0.67ng/mL	Serum	2[2]
Fluorescence	0.048–0.42 U/mL	6mU/mL	Human serum	3[3]
Colorimetric	0.09-3.12μg/mL	0.03μg/mL	Serum	4[4]
Fluorescence	6ng/mL-25.0μg/mL	6 ng/mL	FBS	5[5]

Table S2. Zeta potentials for gold nanoparticles under different conditions

Sample	Zeta potential/mV
4-MBA-AuNPs	-31.6
4-MBA-AuNPs-protamine	-36.1
4-MBA-AuNPs-protamine-heparin	-33.4

References

1. G. Qu, G. Zhang, Z. Wu, A. Shen, J. Wang and J. Hu, *Biosensors & bioelectronics*, 2014, **60**, 124-129.
2. X. Peng, Q. Long, H. Li, Y. Zhang and S. Yao, *Sensors and Actuators B: Chemical*, 2015, **213**, 131-138.
3. M. Yang, J. Chen, H. Zhou, W. Li, Y. Wang, J. Li, C. Zhang, C. Zhou and C. Yu, *Biosensors & bioelectronics*, 2016, **75**, 404-410.
4. R. Cao and B. Li, *Chem Commun (Camb)*, 2011, **47**, 2865-2867.
5. S. N. Ding, C. M. Li and N. Bao, *Biosensors & bioelectronics*, 2015, **64**, 333-337.